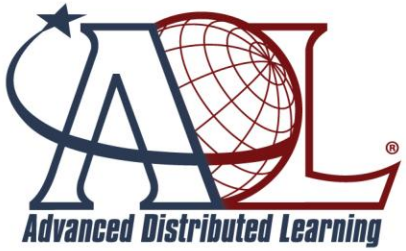
iFest 2012



The Power of Global Collaboration

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Vanilla, Chocolate, or Chunky Monkey: Flavors of Adaptation in Instructional Technology

Dr. Paula J. Durlach, Deputy Director, ADL Initiative

Adaptive Instruction

Instructional content and/or strategy, tailored to the needs and ability of the student

Increasing DOD interest in adaptive instruction

both

Face-to-Face

Technology-Enabled

Adaptive Instruction

- Not just one method –Many “flavors” of adaptation
- Still an art (not a science)
- Serious effort to make dL more adaptive must
  - Consider the different flavors
  - Consider ease of implementation
  - Consider the bang for the buck
  - Overhaul use of IMI levels as a method of describing dL
    - Because it doesn’t explicitly address adaptation

Still more of an art

- Scientific evidence on effectiveness of different adaptive flavors is patchy
- Most of those confound multiple adaptive interventions—so can't id which is responsible
- Same tactic can be implemented in different ways – devil is in the details!

Flavor Selection

- Need a way to display all the flavors and taste test!

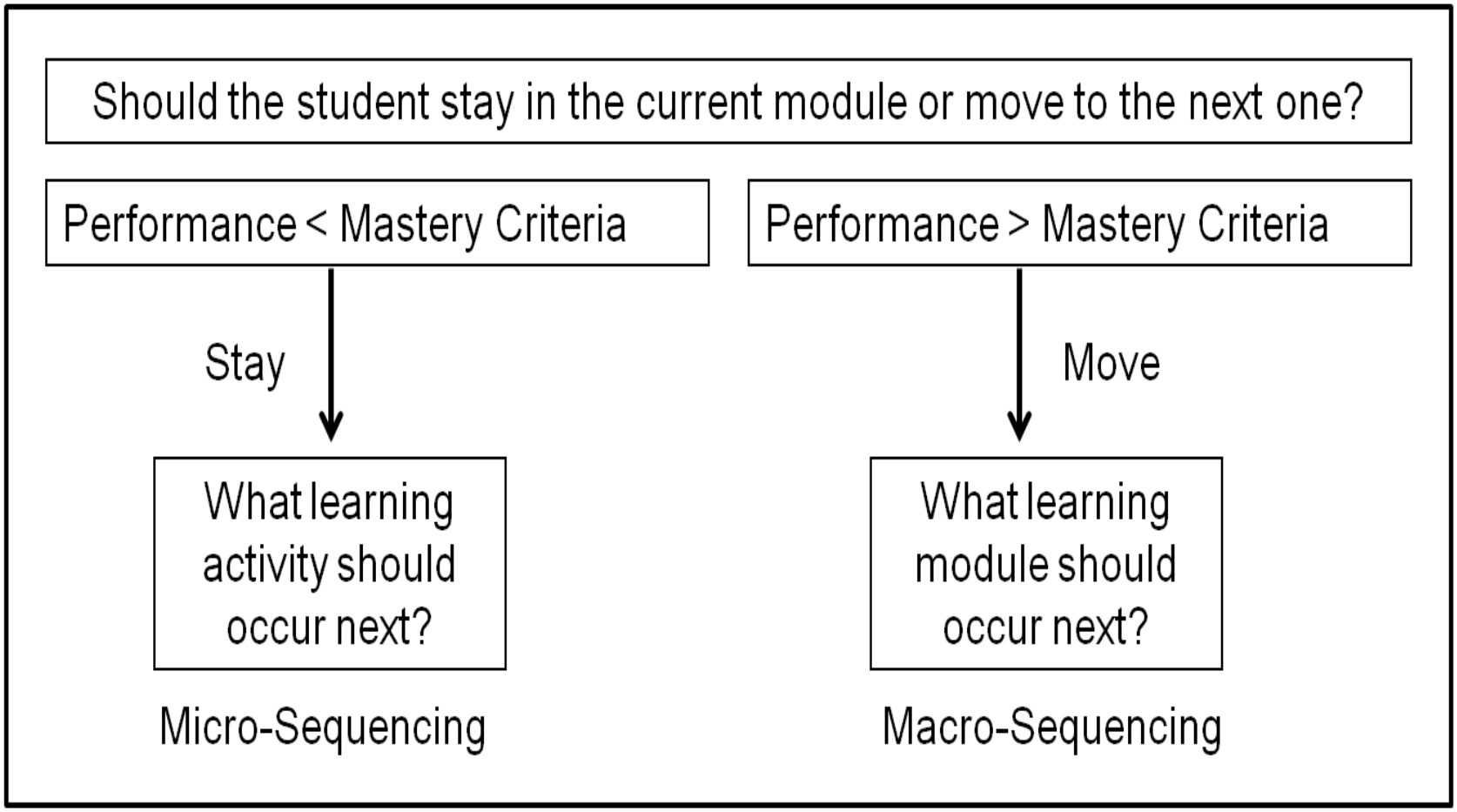
and figure out which go best together

- Framework for Instructional Technology (FIT)

FIT Assumptions

- Feedback is fundamental to learning. The framework must therefore address feedback as a category of intervention.
- Scaffolding is a crucial aspect of human tutoring. The framework should address different forms of "scaffolding."
- We know mastery learning works. The framework must address decisions involved in implementing mastery learning.

2 Mastery-related Decisions



4 FIT Decision Categories

- Corrective Feedback (0-4)
- Macro-Sequencing (0-4)
- Micro-Sequencing (0-4)
- Support (0-4)

- 0-4 roughly correspond to “levels” of adaptation: how sophisticated are the data used to make the instructional decision?

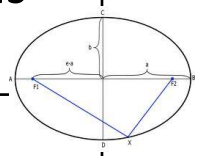
Corrective Feedback

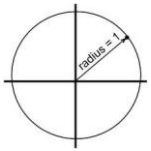
Level 0	No explicit feedback – only summary score
Level 1	Minimal feedback (accuracy information on items)
Level 2	Correct answer or explanation of correct answer on items
Level 3	Error-sensitive feedback – explains why particular error is incorrect (compare & contrast to correct answer)
Level 4	Contextually-adaptive feedback (student may be given different feedback for the same input, under different circumstances). Example: if the student is nearing mastery, then the feedback might be delayed until the end of a problem, whereas a more novice student might be given step-based feedback immediately.

You scored 69%

Incorrect

The correct answer is ellipse





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Good Evidence effectiveness Level 3 > Levels 0-2

Needs student model

Lack of evidence if Level 4 > Level 3

Support

Level 0	No support
Level 1	Fixed hints on request (problem determined); other fixed sources of information (e.g., glossary); prescriptive prompts
Level 2	Locally-adaptive hints, prompts, or pumps (hint or prompt is selected on the basis of information about the latest student response, or lack of a response)
Level 3	Contextually-adaptive hints, prompts or pumps (True Scaffolding--takes into account the student's past performance on the task)
Level 4	Same as Level 3, with interactive dialog (NLP)

Everyone gets the same advice

Advice tailored to local performance

Same error can result in different prompts

Dialog helps student arrive at understanding

Support

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Level 2	Locally-adaptive hints, prompts, or pumps (hint or prompt is selected on the basis of information about the latest student response, or lack of a response)
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Level 4	Same as Level 3, with interactive dialog (NLP)

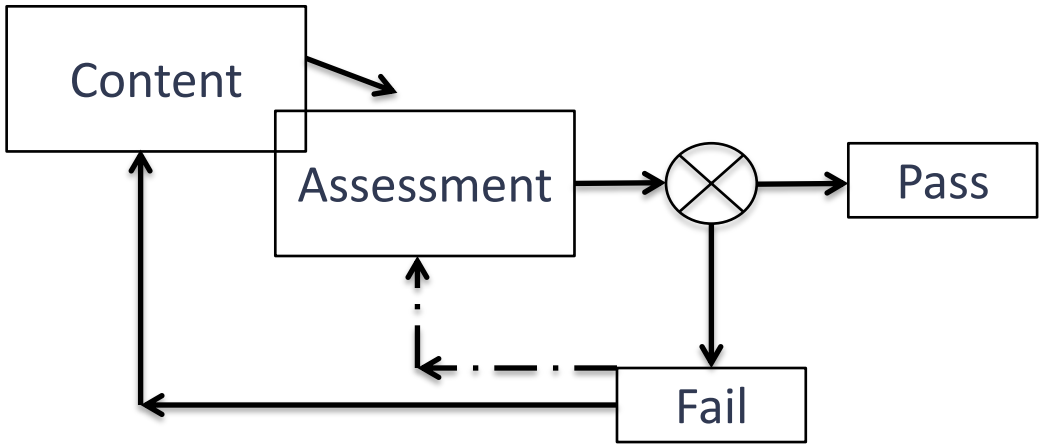
Lack of evidence if Level 4 > Level 3 > Level 2

Best Practice: Lead student to the current solution (use at least Level 2)

Need student model

Micro-Sequencing Level 0

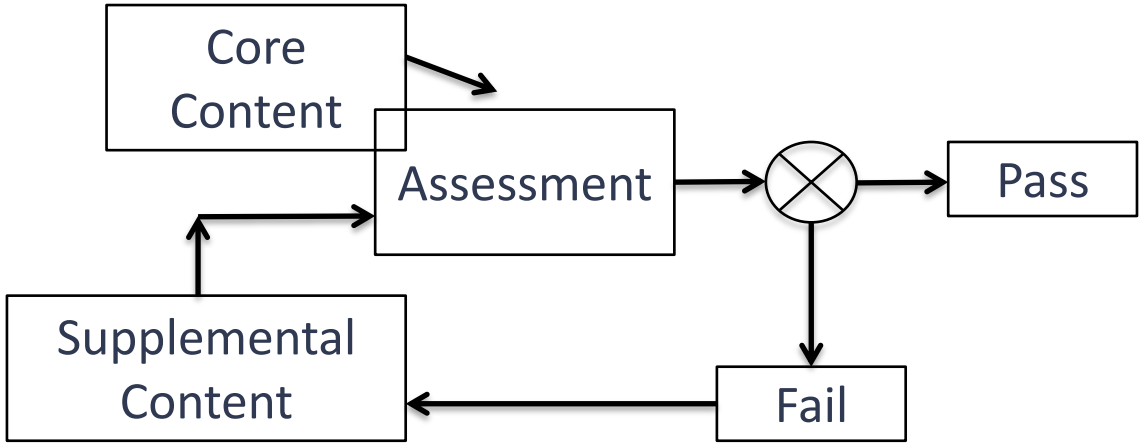
- Recycling



Mastery criterion is a single summary score. Students repeat same material until mastery criterion is achieved. Some versions allow re-assessment without requiring review.

Micro-Sequencing Level 1

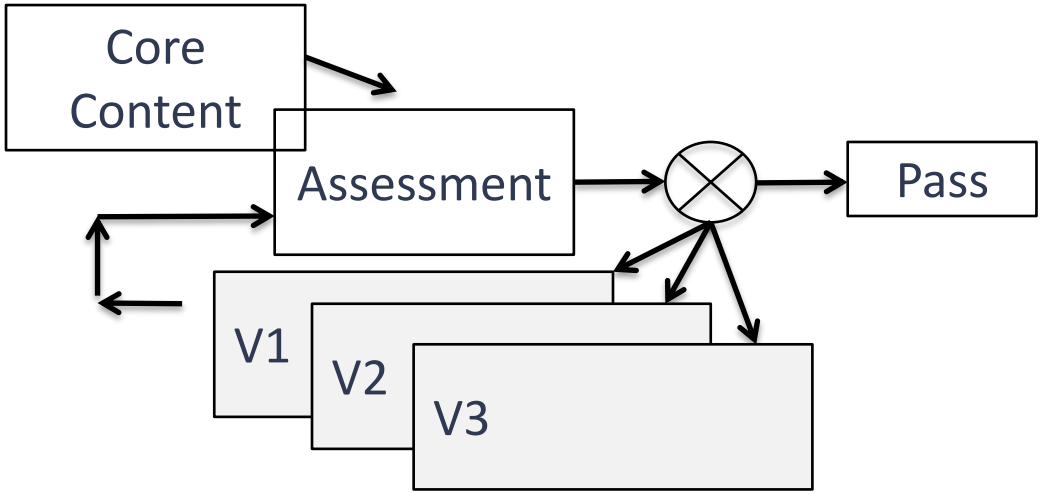
- Supplemental Remediation



Mastery criterion is a single summary score. Students who have not achieved the mastery criterion are given supplemental materials or problems until mastery can be demonstrated. Supplemental materials are same for all students (who need them).

Micro-Sequencing Level 2

- Supplemental Remediation Levels



Same as Level 1, except there are alternate versions of supplemental materials. Version assigned to the student could depend on (1) size of the gap between student's score and the mastery criterion, or (2) whether student has gone through supplemental remediation already, but still not achieved mastery.

Micro-Sequencing Level 3

- **Supplemental Adaptive Remediation**
  - Students must meet mastery criteria associated with knowledge components.
  - All students experience the same core content until mastery assessment is complete.
  - Students unable to demonstrate proficiency on all knowledge components are given supplemental materials or problems targeted at their own specific areas of conceptual weakness.
  - Remedial content is different for different students, depending on their particular pattern of deficiencies.

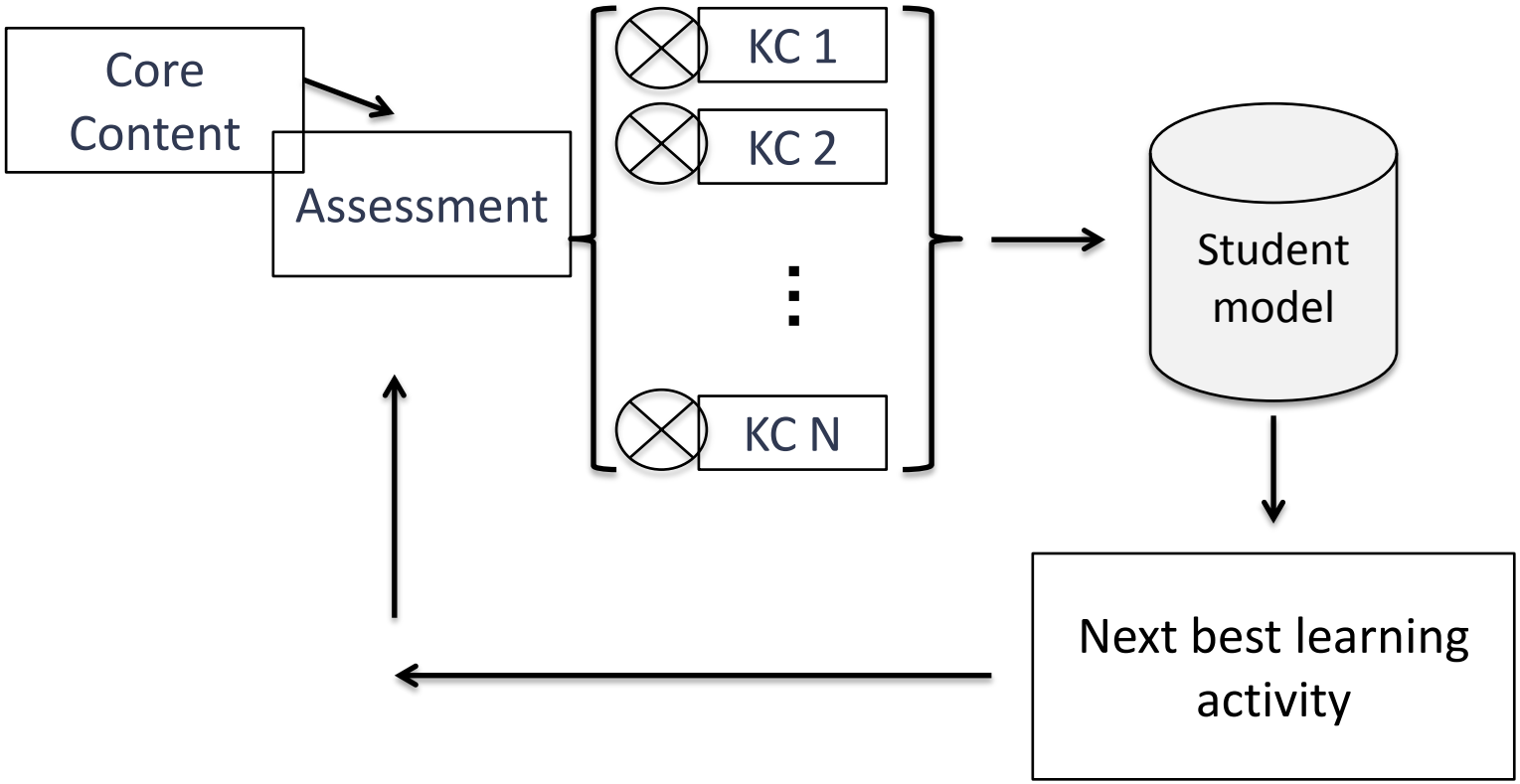
Knowledge Components

- Similar to Learning Objectives (LOs)
- Pattern of scores indicates mastery levels for different LOs
- Key to adapting subsequent remediation to student needs
- Example: these students have the save summary score (8/12), but should be remediated differently

Example

KC	Question	Student 1	Student 2
1	1	✓	✓
	2	✓	✓
	3	✓	✓
	4	✓	✓
	5	✓	X
	6	✓	X
2	1	✓	✓
	2	✓	✓
	3	X	✓
	4	X	✓
	5	X	X
	6	X	X

Micro-Sequencing Level 3



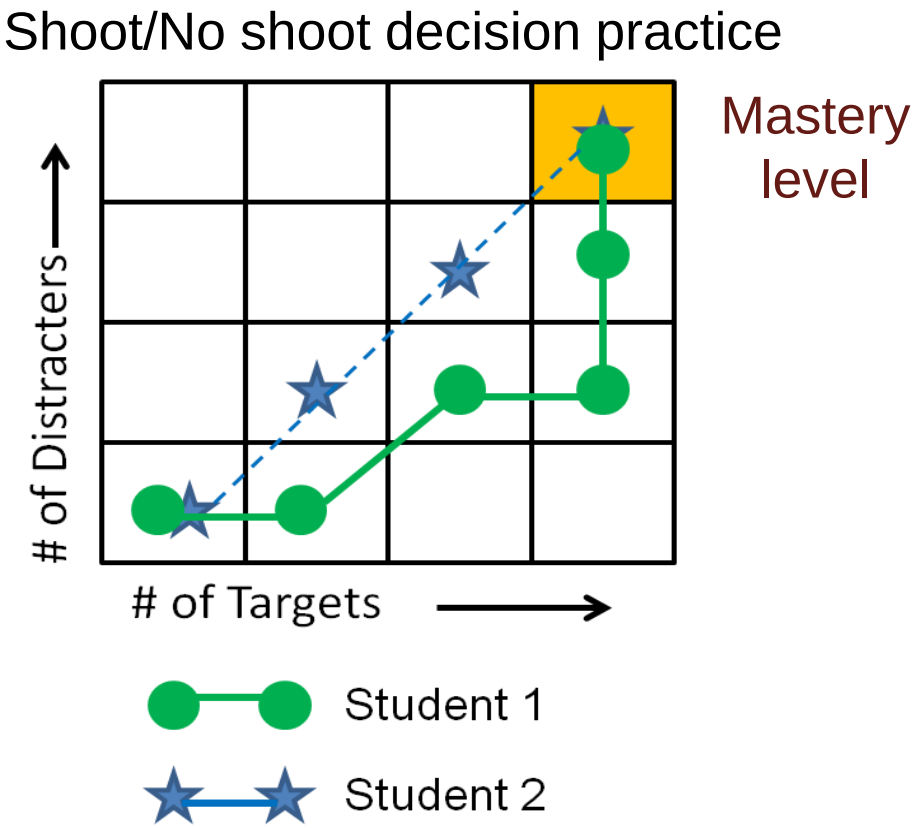
Micro-Sequencing Level 4

- **Adaptive Content**
  - Students must meet mastery criteria associated with knowledge components, but may experience different content on the way to demonstrating mastery.
  - Ongoing assessment determines the sequencing of content, with higher performing students progressing faster and possibly skipping content. Core content experienced by all students may be given at the beginning, forming the basis of the initial performance assessment.

Level 4 example

Adaptive Content

Depending on their performance, two students may progress through a different sequence of practice scenarios to get to mastery.



You don't necessarily need a complex student model to do this!

Micro-Sequencing Evidence

- Some evidence: Levels 2, 3, 4 > 0 (Recycling)
- Some evidence: Levels 3 & 4 > 1 (Supplemental Remediation
- Not much evidence comparing effectiveness of vs. 2 vs. 3 vs. 4

Macro-Sequencing

Level 0	No sequencing decisions, only one module or learning event.
Level 1	Fixed, Student Choice, or Hybrid
Level 2	**Test-out** (Students may skip modules based on a pre-course assessment of their incoming knowledge)
Level 3	**Role Adaptation** (Different students complete different modules depending on their job role. There may be some core content done by all students before their learning paths diverge based on role)
Level 4	**Performance-Adaptive** (Order in which conceptual topics are studied is fixed; however, content for the same conceptual topic may be presented differently to different students, depending on assessment of their performance on prior modules. E.g., higher performing students may be given more advanced materials & vice versa)

Evidence
4 > 2

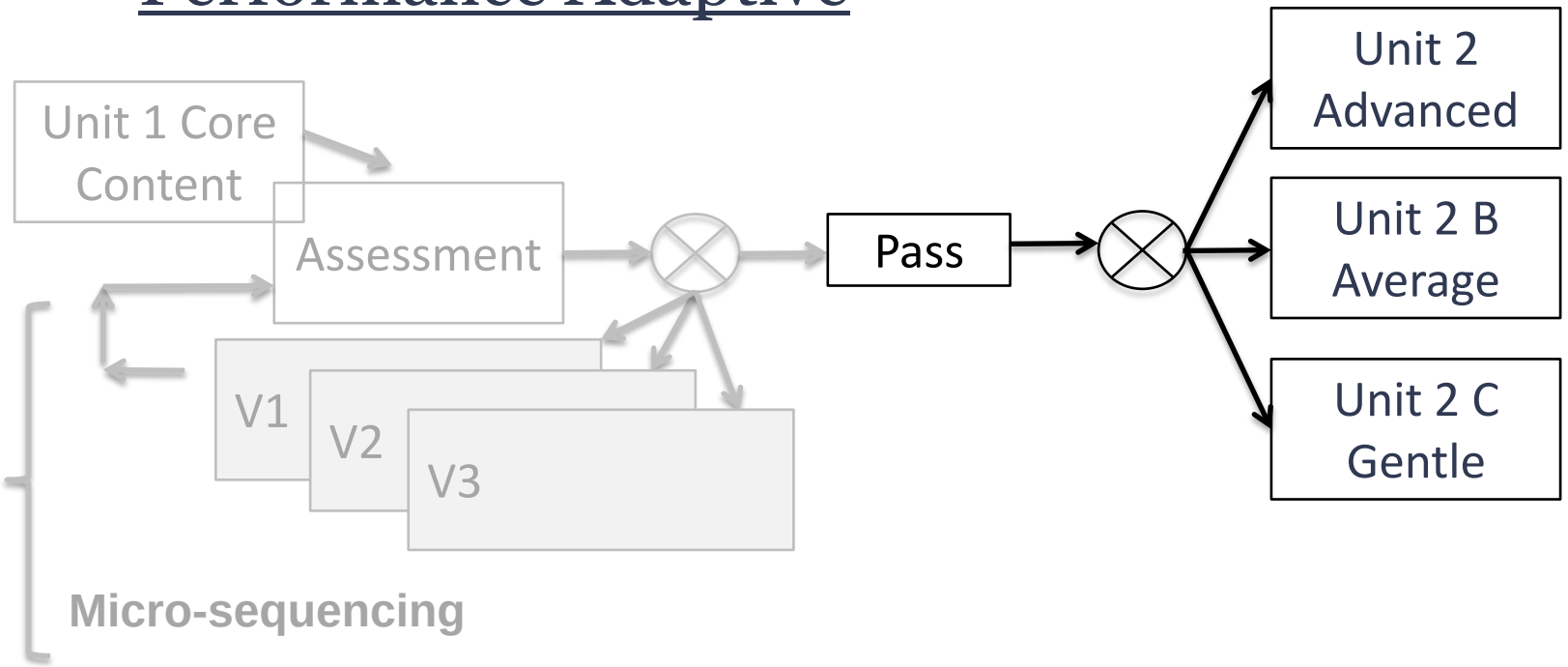
Needs good assessment !!!

Needs role data

Doesn't always need student model

Macro-Sequencing Level 4

- Performance Adaptive



Similar to micro-sequencing with supplemental levels of remediation ; except here the alternate versions are in the next module

Summary

- 4 types of adaptive decisions to be considered when designing/procuring dL
  - Corrective Feedback, Support, Micro-Sequencing, Macro-Sequencing
- Each of these has (at least) 5 variations, roughly corresponding to sophistication/required resources
  - Macro is exception (not a clear continuum)
- Current method of describing dL in IMI levels ignores these decisions
- That method should be revised to take adaptive instructional decisions into account

Sequencing & SCORM

- SCORM 2.0 *can* support all these levels of sequencing
- BUT, it is hard…requires expert SCORM programmer
- Next gen of SCORM should target making achieving more sophisticated sequencing easier

Guidance

- The more elaborate your flavor of adaptation, the more resources you will require.
- Evidence + my guy feel: go for
  - Error-sensitive corrective feedback
  - Locally adaptive support
  - Micro-sequencing using supplemental remediation levels
  - Macro-sequencing (role or performance adaptive)
- These methods do not necessarily require a huge amount of additional effort or resources
  - Going to levels requiring a student model may be an order of magnitude more difficult (right now, it is R & D), and may not necessarily provide ROI.

Questions?

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U.S. Army Research Institute
on assignment to ADL

Back up slides

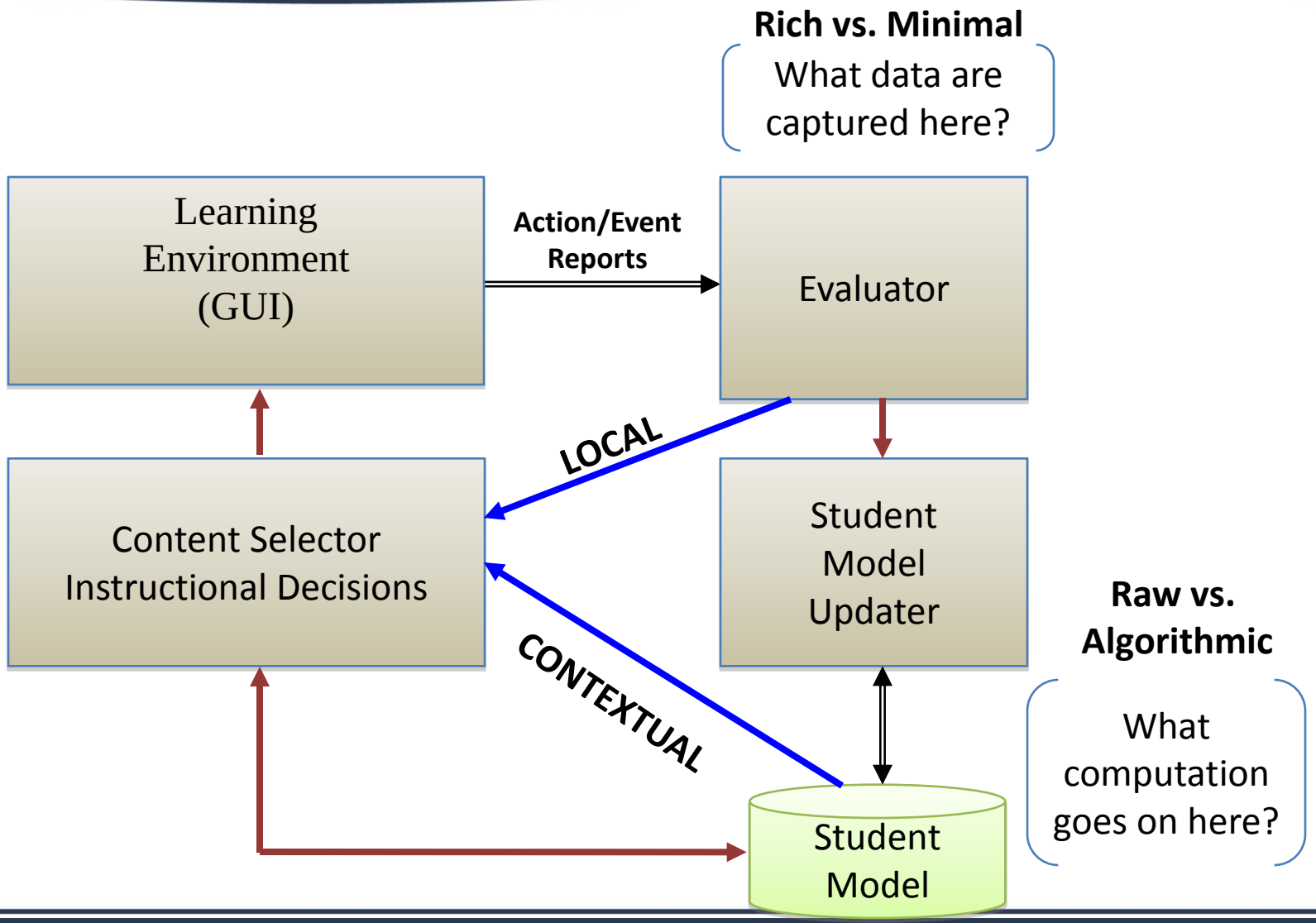
Interactivity vs. Adapation

Interactivity	Adaptation
Feedback is implicit	Feedback is explicit (and may also be prescriptive)
Feedback based on simulation models – what would happen in real world?	Feedback based on assessment of student action in context – was it a good or bad thing to do?
Example: Vehicle goes into a skid if driving too fast on an icey road	Example: You're driving too fast for such an icey road.

What is a student model?

- Some adaptive instructional interventions don't require a full-fledged "student model." Are they good enough?
- What is a full-fledged student model anyway?
  - Local vs. Contextual data – when was the data collected?
  - Rich vs. Minimal data – what data are used for adaptive decisions?
  - Raw vs. Algorithmic – what computations were performed on the data?

Data for Adaptive Decisions



Revamp IMI Levels

- IMI levels 1-4 don't address adaptation issues
- People have trouble distinguishing levels 2 and 3
- One dimensional characterization is insufficient

IMI Level 2		IMI Level 3
Limited participation	That gray area	Complex participation
The student makes simple responses to instructional cues		The student makes a variety of responses using varied techniques in response to instructional cues

Revamp IMI

- Instructional adaptation
  - Corrective feedback
  - Support
  - Micro-Sequencing
  - Macro-Sequencing
- Fidelity
  - Perceptual
  - Psychomotor
  - Functional
- Student Control
  - Sequencing
  - Timing
  - Response Options
- I/O devices
- Engagement